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# WASH WATER SALVAGE AT CHAMPAIGN AND URBANA[1]

## BY HAROLD E. BABBITT

The public water supply of the cities of Champaign and Urbana is obtained from deep wells located in the northern section of Urbana. The water is pumped into a collecting reservoir and thence passes through an iron removal plant of the rapid sand filter type, with a nominal capacity of 2,000,000 gallons per day. No chemicals are used in the process of iron removal, aeration being sufficient to cause the precipitation of the iron. Much of this precipitated matter is caught on the sand grains of the filter, and, because of its tenacious or gelatinous qualities, causes difficulties in the operation of the filters. Wide and deep cracks formed in the filtering material similar to mud cracks seriously affect the quality of the effluent from the plant and necessitate the use of large quantities of wash water. A complete description of the iron removal plant of the Champaign and Urbana Water Company was presented before the Illinois Water Supply Association last year, by Professor Talbot.

During the summer of 1914 the amount of wash water used at the plant was estimated at anywhere from 6 per cent to 20 per cent of the nominal capacity of the plant. A figure in the neighborhood of 8 to 10 per cent is probably a fair value. The loss of 150,000 to 200,000 gallons of water per day is equivalent to a little more than the output of one of the wells from which the water is taken. On the basis of the rates charged the consumer for water, it amounts to about $3750 per year. The cost of a well complete for service is about $2000. An appreciable financial outlay would be justified which would save a large portion of this water.

The idea was conceived that by collecting the used wash water in a sedimentation basin the greater portion of the matter removed from the filter would settle out and the water be usable again. As a result a reservoir with a capacity of 90,000 gallons was constructed in the fall of 1914 and put into immediate use. The cost of this reservoir was $1987, including pump, motor and pump house. This represents a saving over the construction of a new well at the same initial cost, in that the operation, maintenance and depreciation on the reservoir are less than that for a well. The reservoir is successful in saving all but about 16,000 gallons per day, and represents an appreciable financial saving. The financial advantage is enhanced by the greater amount of water rendered available, not always an easy factor to obtain at any cost.

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[1] Read at the first annual meeting of the Illinois Section, American Water Works Association, March 10, 1915.

The wash water reservoir is a reinforced concrete structure with monolithic walls. It is rectangular in plan with a depth of about 12 feet, almost entirely in excavation. The location of the reservoir is such as to cause difficulty in its construction. It is six feet south of the collecting or raw water reservoir which was disturbed in making the new excavation. This necessitated extra precaution in the amount and the strength of the form bracing. The difficulties and haste of construction account somewhat for the relatively high cost.

Since its construction the reservoir has withstood the difficult conditions of filling and emptying twice daily in all weathers without signs of deterioration, leakage, or weakness—other than a crack in the floor above the end of the inside footing of the wall next to the collecting reservoir. Indications are that this crack is due to unsatisfactory foundation conditions. Imperviousness in the concrete was sought by making a dense mixture in the proportions of 1 cement, 2 sand, and 4 stone and applying two coats of Ironite after the setting of the concrete. The character of the water is such, however, that no provisions for this purpose were necessary. Cracks of large size would immediately be filled by a gummy deposit of iron successfully stopping them from the passage of water.

The reservoir receives the wash water discharged from the filters at the two daily washings at 8 a.m. and at 4 p.m. The water for washing is drawn directly from the clear water basin and discharged into the filters by an 8-inch centrifugal pump. After passing through the filter the wash water is dosed with 2 grains of alum per gallon, roughly measured, and passes to the wash water reservoir where it is allowed to stand for about two hours. Clarification is rapid, but all the time available for settling is made use of. The supernatant liquid is pumped from the reservoir through a floating suction pipe into the collecting reservoir. Six to twelve inches of slushy material are allowed to waste into the sewers after each pumping. The actual amount of wash water entering the sewers is thus about 0.8 per cent of the capacity of the plant. The amount of water used in washing the filters is about the same as before the installation of the wash water reservoir.

The effect of settling the water without the use of a coagulant was tried. It was found that about 18 hours settling were required before the water could be pumped back into the collecting reservoir. As better results were obtained from the filters by two washings per day, coagulant was applied to accelerate the rate of sedimentation. The effluent from the coagulated water is clearer than from the non-coagulated, but it seems no easier to handle in the filters.

The effect on the filters of passing the settled wash water mixed with raw water through them has been to increase the loss of head after washing from 14 or 18 inches to 24 or 36 inches, and the head loss before washing from 40 or 60 inches to 48 or 72 inches. The character of the effluent is not detrimentally affected.

In the discussion of Professor Talbot's article, last year, Mr. W. W. De Berard suggested that some of the difficulties encountered by the necessity for frequent washing of the filters with a fire hose or by other laborious means might be overcome by using an additional wash water manifold immediately above the sand layer. Such a grid was constructed by Mr. W. I. Ainsworth, operator of the plant, of old material on hand, supplemented by a few new fittings. The grid is made up of a two-inch wrought iron pipe manifold with $\frac{3}{4}$-inch branches on 11-inch centers. One-eighth inch holes on 5-inch centers are bored on the under sides of the pipe and manifold. The grid covers only one-half of the area of the filter, but because of the clogging of the $\frac{1}{8}$-inch holes by the iron deposits only one-quarter of the area of the filter is affected by the grid. The result, however, has been to obviate the necessity of washing this unit with a fire hose. The loss of head on this filter after washing will increase from 18 inches to 24 inches, in the same time that the adjacent units are increasing from 18 inches to 52 inches. It is planned to install similar grids with $\frac{3}{16}$-inch holes on all the filters.

## *DISCUSSION*

MR. W. W. JENNINGS: Does the reservoir have a hopper-shaped bottom and how often is it washed?

Mr. Babbitt: The bottom of the reservoir is a single plane surface sloping from a depth of 12 feet on one corner to a depth of 13 feet on the diagonally opposite corner, a distance of about 40 feet. The reservoir is drained after each washing, the total amount of water entering the sewers being about 0.8 per cent of the capacity of the plant.

Mr. W. W. De Berard: Before finally putting the auxiliary grid in all of the filters further experiments should be made to learn the maximum spacing permissible between orifice opening and between laterals. Mr. Babbitt reports that the whole filter needs no hand hosing, although one-half of the surface only is covered and further only one-half the holes in this grid are open. It was the intention at Oakland, where we carried out the original experiments for the People's Water Company, to ascertain this point but we never got that far. Would it not be the logical thing to double up the distance between laterals and increase somewhat the orifice openings? This will cheapen the grid cost and make it more likely to be tried elsewhere. It is pleasant to learn that the results of experiments carried on eight years ago are being made use of with such good results.

In passing it may be said that we tried pointing the jets in all directions. When directed in any but downward, sand was shot out over the edges of the gutter. Not much added impetus is required to project a sand grain to the gutter under such condition.

This means of applying the wash water is the only one which the speaker knows that will allow one to take advantage of the jet action, and thus to produce the attrition of one sand grain against another. No filter strainer made produces a jet action more than a very few inches from the orifice. It would be a detriment to the system if it did, for the action would be taking place on clean sand grains. To make jet action effective it must be applied at a point where the dirty sand lies at the top of the bed.